MIS NEWSLETTER

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mis celebrity

Phil Stover, WED-DACS, has become something of a celebrity since his Micro-Mice, *"Moonlight Special"*, *"Moonlight Flash"* and *"Moonlight Express"* won the "Amazing Micro-Mouse Maze Contest" and other awards at last June's National Computer Conference in New York.

You might have seen articles in the *Disney News*, *Computerworld*, *People* and *OMNI* magazines and several other periodicals. But the editor of the newsletter thought you'd like a little more information on Phil and his project. So, on a bright Thursday morning I interviewed Phil, asking questions I thought would be of general interest:

Phil Stover seated in front of the new Data General S-250 Eclipse System at DACS-WED

How did you get interested in the contest, what was its purpose and what were some of of the rules?

Phil and several of his associates at Battelle Memorial Institute Research Laboratory in Richland, Washington (his former employer) saw a contest announcement in a fall '77 edition of *Spectrum* magazine (official publication of the IEEE). The challenge of the project interested them (and apparently 6,000 other entrants) and they sent in their $3.95 for the entrance forms and rule book.

The overall purpose of the contest (sponsored by *Spectrum* and *Computer* magazines and several large electronic equipment vendors) was to call attention to the rapidly advancing world of microprocessing. A more immediate purpose was to produce a mouse that could run the maze fastest. Phil and company defined their goal as creating a "unique, small, self-contained, intelligent, mboile robot".

The rules specified maximum size (10" x 10") described the maze and outlined the procedures of the contest. There were to be five elimination time trials before New York, contestants could not see the mazes before the trials, mice had to be "caged", the units had to be entirely self-contained, could not jump or fly over maze walls and could not be touched once in the starting block.

Phil and his friends went to work. Together they spent a total of 1,000 hours of leisure time (thus the "Moonlight" in the names of their mice) and their own

expenses to attend the time trials held on both coasts. They soon discovered that their creation was more sophisticated than their competitors'. It was intelligent while others just hugged the walls of the maze. But the non-intelligent models were faster. That's why Phil and buddies actually ended up making three mice - the last of which, though not as sophisticated, was faster.

How do the mice process data?

The mice use infrared optical sensors and a Zilog Z-80 microcomputer. In negotiating the maze, it never contacts the walls, but relies instead on its optical sensors for direction. Motor control, guidance, and decision logic are implemented entirely in software, in 2K bytes of EPROM.

The program is divided into two parts: an interrupt-driven foreground routine for stepper-motor control and sensor scanning; and a background loop that responds to wall sensor readings and makes "next-move" decisions, while operating at four distinct logical subroutine levels. (See fig. 1)

Each functional level can be thought of as a specific level of intelligence. Level 1 provides basic transportation facilities. It interfaces with the mouse's two motors and five sensors to execute four maneuvers: turn left, turn right, go straight, and turn around. Also included at this level is the guidance control necessary to prevent contact with the maze walls. Near the end of a 7-inch trip in any of these directions, level 2 interpretes level 1's wall sensor readings and makes the next move decision if there is only one choice. Level 2 also keeps track of the mouse's current position in an x, y-coordinate system referenced to the maze entrance.

When the mouse reaches a node (three-way crossing), level 2 asks level 3 to make the decision as to which way to go. Level 3 executes an algorithm that insures that the mouse will find the exit. Relying heavily on the mouse's RAM, this level places logical blocks at the entrances to any dead-end passages, and prevents the mouse from returning to the maze entrance. Level 3 uses a random function generator to make choices at new nodes, to give the mouse a best solution in an arbitrary maze configuration. This level is the highest intelligence the mouse needs to complete any single run.

In the case of the 1st mouse, level 4 was required to give the mouse the ability to learn from one pass to the next. A refinement in the 2nd mouse computes the shortest path through a loop on three tries.

The mouse has five eyes. One eye looks straight ahead to "see" an upcoming wall. Two, on the sides, detect side walls. The other two, between the side-wall and front sensors, guide the mouse down the center of a path.

Each eye consists of a separate light source (infrared light-emitting diodes) and a receiver (a photo-darlington transistor). To get the largest signal-to-noise ratio, both LED and phototransistor have built-in lenses that concentrate the light. Infrared filters remove most ambient light, such as that from flourescent lamps.

The output of each of the phototransitors is amplified, and then digitized in a comparator. The comparator outputs are tied to an input port on the microcomputer where they can be sampled.

One of the remarkable things about the 2nd mouse is the amount of intelligence and capability that can be put into such a small space - everything is on a single 5 by 5 inch circuit board. The Z-80 microcomputer, which uses just half of the

space, consists of four sections: processor, memory, input/output, and clock. The clock is used to sequence the processor and to provide a reference for controlling devices simultaneously. The memory consists of 2K bytes of program memory and 1K byte of node-storage memory.

A stepper motor drives each of two wheels. The processor has direct control over speed and direction applied to each motor. Turns are made by driving the wheels in opposite directions.

Should the need arise for a higher level of communication with the Z-80 microcomputer, there is a jack to connect a computer terminal with which an operator can examine and modify the computer's memory and control program execution. This feature is useful in debugging enhancements to the software. The Z-80's program is coded in Z-80 assembly language and was cross-assembled using a Digital Equipment Corporation PDP 11/70 minicomputer.

Some Other Micromouse Strategies:

PREGNANT MOUSE

At each turn in the maze this mouse gives birth to another pregnant mouse, which in turn gives birth to another, until eventually all possible paths are tried.

JET PROPELLED MOUSE

Dumb, but fast.

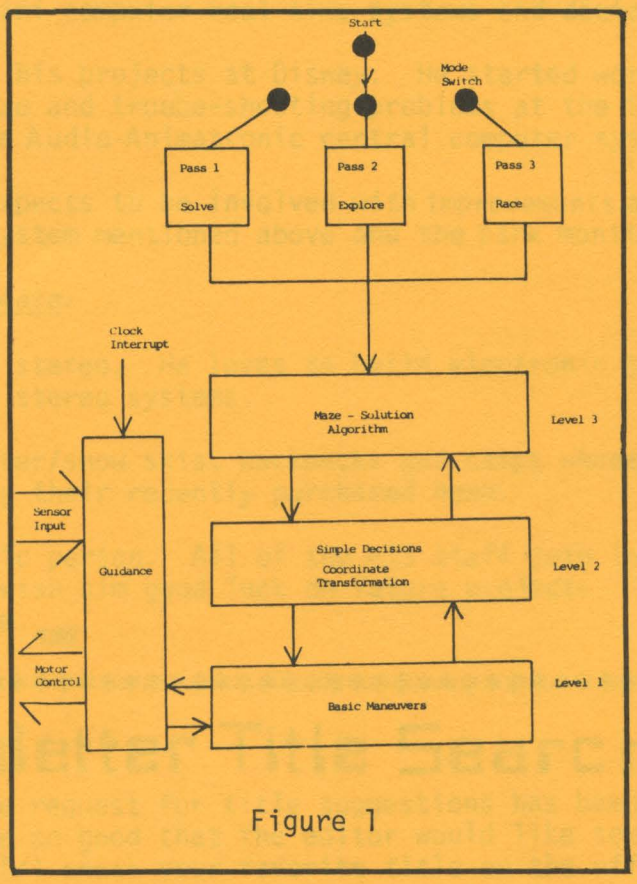
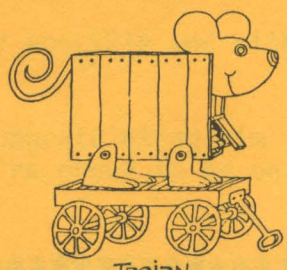


Figure 1

KANGAROO MOUSE

Jumps over the walls.



TROJAN MOUSE

Rolls across starting line, opens a door, and releases thousands of mice to try different paths.

What prizes did you win in New York?

Phil and friends actually won three prizes. They won the $1,000 for the fastest mouse (*"Moonlight Flash"*) an oscilloscope for creating the fastest learning mouse (*"Moonlight Express"*) and a CRT terminal for producing the best paper in the *Personal Computer Proceedings Journal* (*"Moonlight Special"*). So actually all three of their creations were winners.

How do you plan to spend the money?

Almost all of it will go for travel expenses and the party that Phil and his friends are throwing later this year for all those who helped them at Battelle.

What's happened since winning?

Phil's been approached by several interested book/periodical authors/publishers. There's also some talk about a European championship in London in 1980. Then there's always the next "project". The group is currently "fishing around" for one.

What's your Disney experience, what projects are you currently working on and what's in the future?

Phil started at WED in November of 1978. He came to us after four years with Battelle. After graduating with his EE degree from the Universition of Washington, he worked on computer simulators for Boeing Aerospace for a short period, and then went back to Stanford for his master's. While there he got interested in digital circuit design and mini-computer real time systems and decided to stay with that.

He's excited about his projects at Disney. He started working on the ACES Camera in developing software and troube-shooting problems at the Studio. He's now working on the 2nd generation Audio-Animatronic central computer system.

In the future he expects to be involved with improvements and support to the Audio-Animatronics system mentioned above and the park monitoring system.

Other hobbies, interests?

Phil's really into stereo. He loves to build electronic *Heathkits* and is most interested in digital stereo systems.

In addition, he water/snow skis, backpacks and camps whenever possible and with his wife is remodeling their recently purchased home.

Phil's one energetic person. All of the MIS staff join in congratulating him on his successes and wish him good luck on future projects. We're proud to be on the same team with him. mis

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Mis Newsletter Title Search

The responses to the request for title suggestions has been gratifying. But the suggested titles are so good that the editor would like some help in choosing "the one". Please (✓) check your favorite title on the official ballot below and return it to Howard Cardon, Studio IE-24 ASAP. The next issue will carry our new title and logo. Thanks for your help.

OFFICIAL BALLOT-MIS NEWSLETTER TITLE

___The Data Communicator
___Bits & Bytes
___The MIS Bottom Line
___The Information Service
___The MIS News Break
___The Network
___MIS: Leading Edge
___MIS: Interpreted
___MIS: Identified
___MIS: Understood
___Prime Time
___/ Update
___Knac & Yak
___MIS Report
___Movin' On
___Sysout

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There are two recent additions to our Disney team since the last Newsletter - one each in California and Florida. Please allow me to introduce. . .

Robbie DeMello - who joined us on June 25th as our Documentation Librarian. Robbie worked close by in Glendale for many years as an Engineering Associate. However, most recently she was working in Century City as a Senior Secretary. (She's glad not to have to make that long commute anymore). She and her family are into sports. Watching her son participate in track and football has kept her busy for years. But she hasn't only been a spectator, she loves to bowl and fish (deep sea) and she says her favorite place is Morro Bay, California. She and her family go there often, but they also love Washington and Oregon. When she does sit still she does needlepoint - a skill that no doubt will serve her well in the library as she looks for that proverbial "needle in the haystack".

Richard Tarr - who started with us on August 2nd as a Programmer/Analyst He holds a MBA and BS in Management and has several years of programming and supervisory experience. Rich comes to us from the Orange County School Board Data Center, where he not only served as a programming supervisor, but also as a consultant to the Board on several special projects. His initial task for us will be to make changes to the Customer Profile System. In his free time, Rich likes to tinker with motors, engines and other mechanical items. He says his car hasn't seen the inside of a garage in years (sound familiar?). He also enjoys woodworking, water skiing, skin diving, boating and flying. In addition, he's an active member of the North Orlando Kiwanis Club. Raised in a military family Rich has lived in many parts of the U.S.A.; in England, Japan and the Phillipines. In addition to his degrees, he holds Real Estate Salesman and Residential Contractor's Licenses and is working on his Florida State Securities License. Obviously, he has absolutely no ambition! mis

TECHNICAL TIPS

August's Tip

Spoolout Control

1) /SYSFILE SPOOL = SYSLST

   Causes the accumulated SYSLST to be spooled without logging off

2) /SYSFILE ERASE = SYSLST

   Erases the accumulated SYSLST file

3) Control of UTS700 printing vs host printer can be obtained for batch tasks by using the 'ACCT' on the ENTER command:

   a) when logged on with normal acct (to spool to UTS700)
      /ENTER filename,,ACCOUNT1
      (your UTS700 spool acct)

   b) when logged on with '1' acct (to spool to host printer)
      /ENTER filename,,ACCOUNT
      (your 'normal' acct) mis

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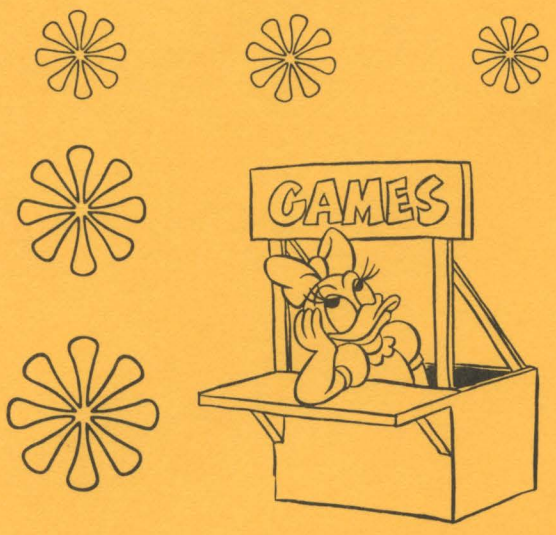

Solutions to Last Months Games

1.

Weigh coins 1, 2, 3 and 4 against coins 5, 6, 7, and 8. If they balance, weigh coins 9 and 10 against coins 11 and 8 (we know from the first weighing that 8 is a good coin). If they balance, we know coin 12, the only unweighed one, is the counterfeit. The third weighing indicates whether it is heavy or light.

If, however, at the second weighing (above) coins 11 and 8 are heavier than coins 9 and 10, either 11 is heavy or 9 is light or 10 is light. Weigh 9 with 10. If they balance, 11 is heavy. If they don't balance, either 9 or 10 is light.

Now assume that at first weighing the side with coins 5, 6, 7 and 8 is heavier than the side with coins 1,2,3, and 4. This means that either 1, 2, 3 or 4 is light or 5, 6, 7, or 8 is heavy. Weigh 1, 2, and 5 against 3, 6, and 9. If they balance, it means that either 7 or 8 is heavy or 4 is light. By weighing 7 and 8 we obtain the answer, because if they balance then 4 has to be light. If 7 and 8 do not balance, then the heavier coin is the counterfeit.

If, when we weigh 1, 2, and 5 against 3, 6, and 9, the right side is heavier, then either 6 is heavy or 1 is light or 2 is light. By weighing 1 against 2 the solution is obtained.

If, however, when we weigh 1, 2, and 5 against 3, 6, and 9, the right side is lighter, than either 3 is light or 5 is heavy. By weighing 3 against a good coin the solution is easily arrived at.

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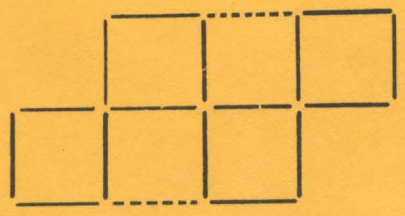
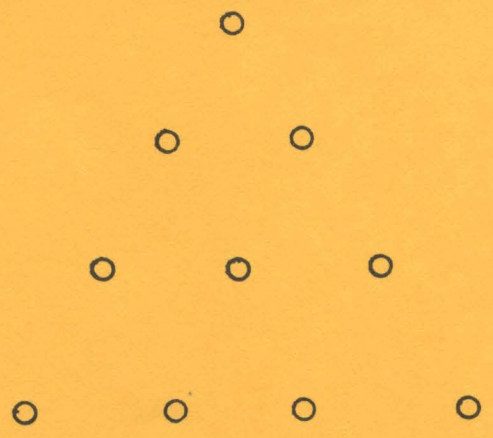
2.



By moving two matchsticks produce four boxes of the same size.

TRY YOUR HAND AT THIS MONTH'S STUMPER



By moving three dots turn this pyramid upside down.

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